

CLAIMS

What is claimed is:

*Sub A7* 1. A sonar beamforming system, comprising in combination:  
a forward-looking sonar having transmit and receive transducer arrays and a  
beamforming device; and  
at least one side-looking sonar having multi-element arrays and a beamforming  
device.

- 10 2. The system of claim 1, further comprising a downward-looking sonar for high-resolution  
terrain and object identification.
3. The system of claim 1, wherein at least one of the forward-looking sonar and at least one  
side sonar are mounted on a pivotable motorized array.
4. The system of claim 1, wherein at least one of the forward-looking sonar and the side-  
looking sonar include multi-mode arrays for at least a detection mode and an  
identification mode.
- 20 5. The system of claim 1, wherein the system further comprises multi-element acoustic  
communication receive arrays.

*Sub A8* 6. A water craft, comprising in combination at least one of:  
a forward-looking sonar having a transmit and receive transducer array and a  
beamforming device; and  
a side-looking sonar having multi-element arrays and a beamforming device.

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7. A forward-looking sonar comprising in combination:
- a bistatic transducer array having a first transmit transducer array and a second receive transducer array;
- a beamforming device; and
- a processing unit.
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8. A method for forming an integrated image comprising the steps of:
- obtaining array signals from a forward-looking sonar;
- obtaining array signals from at least one side-looking sonar;
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- normalizing the array signals from the forward-looking sonar and the at least one side-looking sonar to generate normalized data; and
- fusing the normalized data to generate an image.
9. An underwater unmanned vehicle system comprising in combination:
- a forward-looking sonar having a transmit and receive transducer array and a beamforming device; and
- at least one side-looking sonar having a second transducer array and a beamforming device.
10. The system of claim 9, further comprising a downward-looking sonar for high-resolution terrain and object identification.
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11. The system of claim 9, wherein at least one of the forward-looking sonar and at least one side sonar are mounted on a pivotable motorized array.
12. The system of claim 9, wherein at least one of the forward-looking sonar and the side-looking sonar include multi-mode arrays for at least a detection mode and an identification mode.

13. The system of claim 9, wherein the system further comprises multi-element acoustic communication receive arrays.
- 5 14. The system of claim 9, wherein the beamforming device further comprises a plurality of charge domain delay lines.
15. The system of claim 9, wherein the beamforming device comprises a sampling circuit connected to a programmable delay circuit, a weighting circuit, and a summing circuit.
- 10 16. The system of claim 9, further comprising a memory circuit connected to the beamforming device.
17. The system of claim 16, further comprising an interface controller connected to the memory circuit.
- Sub A 9  
18. The system of claim 17, further comprising a Firewire interface connected to the interface controller and the memory circuit, the Firewire interface communicating with a central processor.
- 20 19. The system of claim 9 wherein the beamforming device comprises a charge domain delay line.
- 25 20. The system of claim 19 further comprising a plurality of charge coupled device delay lines, each delay line having a programmable tap selection circuit.